Mapping Social Vulnerability

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RAMSEY COUNTY

Resilient Communities Project
University of Minnesota
Building community-university partnerships for sustainability

The project on which this report is based was completed in collaboration with Ramsey County as part of the 2018–2019 Resilient Communities Project (RCP) partnership. RCP is a program at the University of Minnesota's Center for Urban and Regional Affairs (CURA) that connects University faculty and students with Minnesota communities to address strategic projects that advance local resilience and sustainability.

The contents of this report represent the views of the authors, and do not necessarily reflect those of RCP, CURA, the Regents of the University of Minnesota, or Ramsey County.

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Resilient Communities Project
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Building Community-University Partnerships for Resilience

GEOG5564 Spring 2019 Final Technical Report
Mapping Social Vulnerability
Ramsey County Project RC 1b

Emily Worman, Pak Ming Chan, Madelline Morgan-Knox

Introduction

Ramsey County would like to expand knowledge about social vulnerability to find out which communities within the county are most vulnerable. By mapping factors that could impact the effectiveness of emergency response and management, this project has the potential to increase the resilience of communities in the face of both natural and human created disasters.

A social vulnerability refers to a community's resiliency capacity in response to an external stressor. To help the county and specific demographic groups better prepare for, respond to, and recover from disasters, this project has identified vulnerability indicators and used them to create maps displaying concentrations of vulnerability. Reducing social vulnerability is important because according to the CDC, it can also reduce human health issues and economic loss.

This project is also important for Ramsey Country as they build relationships and distribute information among communities. The social vulnerability maps and index will be valuable throughout all stages of a disaster cycle, including efforts to mitigate, adapt to, respond to, and recover from an emergency. Mitigation activities are those that reduce or eliminate the probability of a hazard occurring. Adaptation refers to adjustments that are made in response to the actual or expected hazard. Finally, resilience refers to the ability of a community to recover quickly from a disaster. Making emergency preparedness and management resources accessible and effective for all residents is important to Ramsey County, and mapping social vulnerability factors will help them target vulnerable populations increase the effectiveness of their emergency management programs. For example, translating documents to Asian languages such as Karen will hopefully result in efficient dissemination of information. This process fits in with their long-term goal of

building trust and relationships in high-risk communities to improve resiliency and emergency response.

We identified several categories of social vulnerability including socioeconomic, demographic, neighborhood characteristics, and health (see Figure 1). Due to the scope of the project, we were unable to map all these factors. Instead, we worked with officials from Ramsey County Emergency Management and a student team in a Humphrey School capstone course (PA 8081), who also worked on an RCP social vulnerability project, to select which indicators to map. Based on these discussions, three populations were chosen: people over 65, children under five, and limited English in Asian and Pacific Island populations. These indicators were also overlaid with another vulnerability indices, poverty level, as economic status seems to be an important factor.

Social Vulnerability Indicators	
Socioeconomic	Income Education Employment Status / Occupation
Demographic	English Language Proficiency Race/Ethnicity Gender Age Family Structure
Neighborhood Characteristics	Accessibility to Resources Social Capital Physical Infrastructure Transportation Population Density
Health	Disabilities Mortality Rate Sanitation Disease

Figure 1

The remainder of this report will focus on our specific mapping goals, methods, and results.

Objectives

The key objective of the project is to identify and map social vulnerabilities to alert officials

as to where vulnerable populations are located, and when combined with research, to aid them in identifying how the specific vulnerability impacts the communities ability to respond to and recover from emergencies.

Specific Project Aims

- Find up-to-date data about our chosen vulnerabilities
- Map each of the three population groups that are vulnerable
- Map combined vulnerabilities to show areas of extreme vulnerability
- Record our process so that it can be repeated in the future, with different vulnerability indicators

Data Source and Query

As requested by Ramsey County, our data was collected at the block level in order to provide the most detail.

Data

1. Population Group #1: Younger than 5 years old
   Table: Total Population - SEX BY AGE
   Spatial Unit: Census Block
   Data Source: 2013-2017 American Community Survey 5-Year Estimates

2. Population Group #2: Aged 65 years or older
   Table: Total Population - SEX BY AGE
   Spatial Unit: Census Block
   Data Source: 2013-2017 American Community Survey 5-Year Estimates

3. Population Group #3: Limited English Speakers
   Table: Households - HOUSEHOLD LANGUAGE BY HOUSEHOLD LIMITED ENGLISH SPEAKING STATUS
   Spatial Unit: Census Block
   Data Source: 2013-2017 American Community Survey 5-Year Estimates

Anyone over the age of 5 who reported speaking english less than “very well”
Asian and Pacifc Island Households

4. Poverty Status
   Table: Households - POVERTY STATUS IN THE PAST 12 MONTHS BY HOUSEHOLD TYPE BY AGE OF HOUSEHOLDER [B17017]
   Spatial Unit: Census Block
   Data Source: 2013-2017 American Community Survey 5-Year Estimates

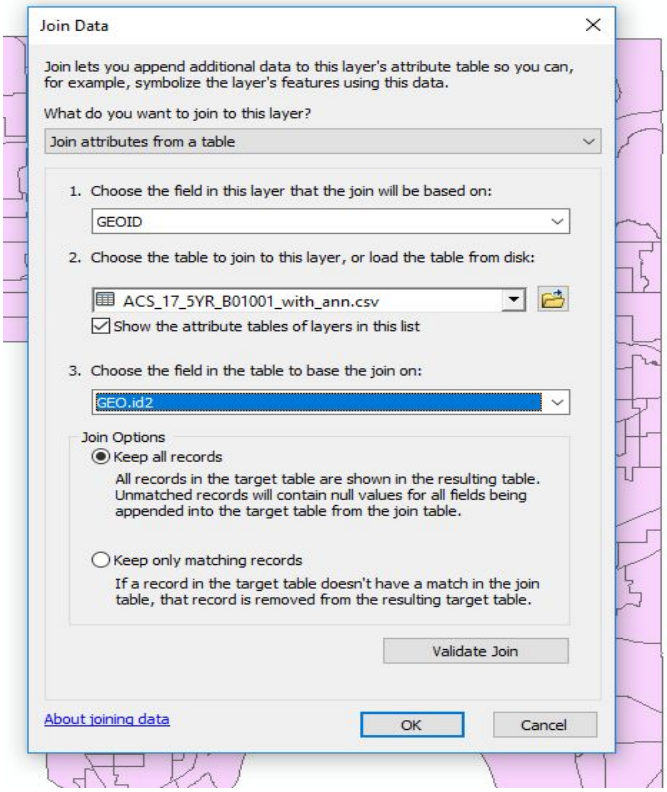
5. Exported from the MN block group shapefile by selecting Ramsey county code: 123 (Codes for the Identification of Counties in Minnesota)

6. Minnesota boundary in block group level (2017) , from 2017 TIGER/Line® Shapefiles: United States Census Bureau

7. Minnesota Lakes and Rivers National Hydrology Dataset from Minnesota Geospatial Commons: https://gisdata.mn.gov/dataset/water-national-hydrography-data

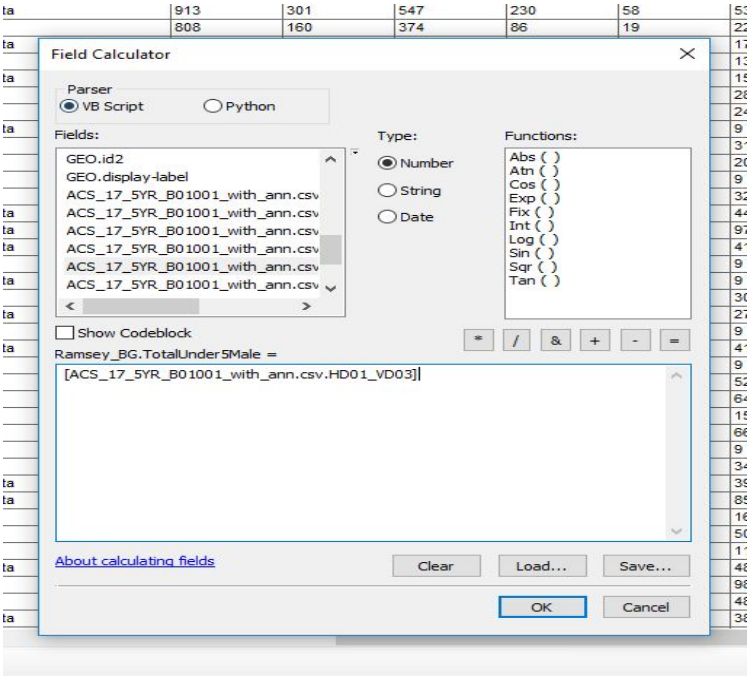
Mapping Process

1. Search for and collect data from the U.S. Census American Fact Finder
   a. The tabs on the left side of the page (Topics, Geographies, Race and Ethnic Groups) can be used to set selection criteria.
   b. To get data for Ramsey county:
      i. Click on the Geography tab,
      ii. Select Block Group - 150 from the drop-down menu,
      iii. Select Minnesota and then Ramsey county
      iv. Select All Block Groups within Ramsey County, Minnesota
2. Data can be further narrowed in the Topics tab to match the demographics or social vulnerability indicators you want to map, and based on the criteria selected, different data sets will be available for you to choose from.

3. Download and extract data
4. Population data must be standardized
    a. Ratio of specific population to the total population in each block group shown as a percentage
5. Join downloaded data table to the Minnesota Block Group data layer in ArcMap
    a. Add .csv file to arcmap
    b. 

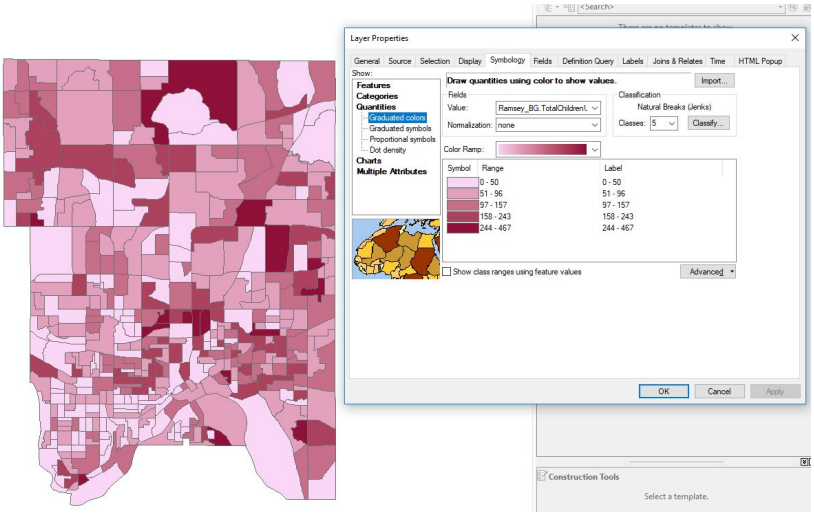
6. Clip tool and join csv.table to Ramsey county feature class.
7. In the joined table, open the attribute table and add a new field

a. Use the Field Calculator to assign values for each new field



b. Join the male and female data fields and use the Field Calculator to calculate their values by adding the data

8. Change the symbology of the map
   a. Choose Natural Breaks (with 5 values) as the classification
   b. Symbolizing the data:



   c. Layout View: 8.5 by 11 scale 125,000

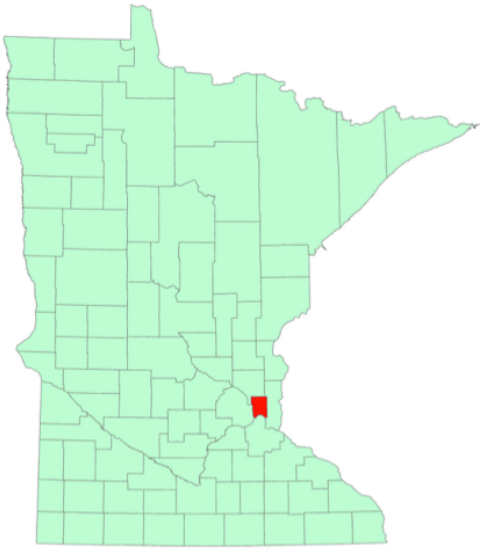
9. Layering Vulnerabilities: Choropleth Mapping
   a. Add poverty layer into population map project, and enable two layers (click both population and poverty layers)

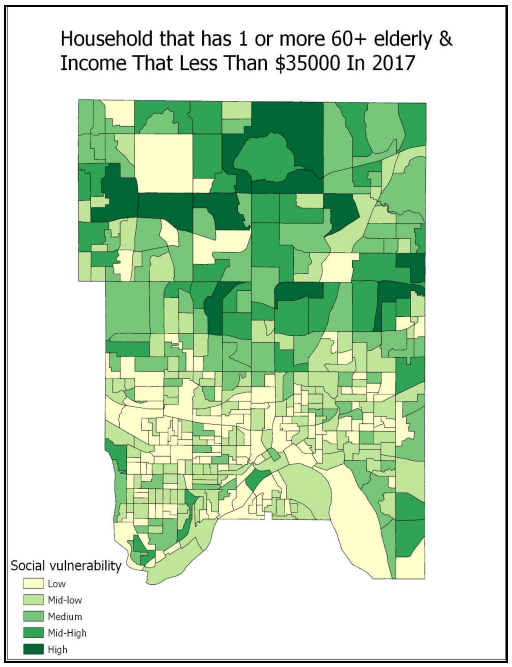
b. Format symbology of the poverty layer from white to transparent
c. Create new layout and add new map
d. To create the bivariate legend, assign colors of all 5 classified classes of population layer into five rectangles according to its RGB code. And overlay with other box (white to transparent)of the poverty layer.

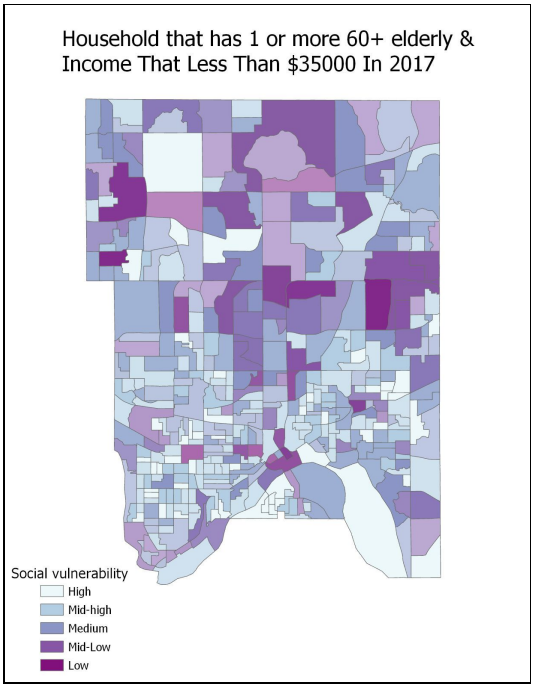
10. Add National Hydrography dataset
    a. To provide context for readers since we did not include road data

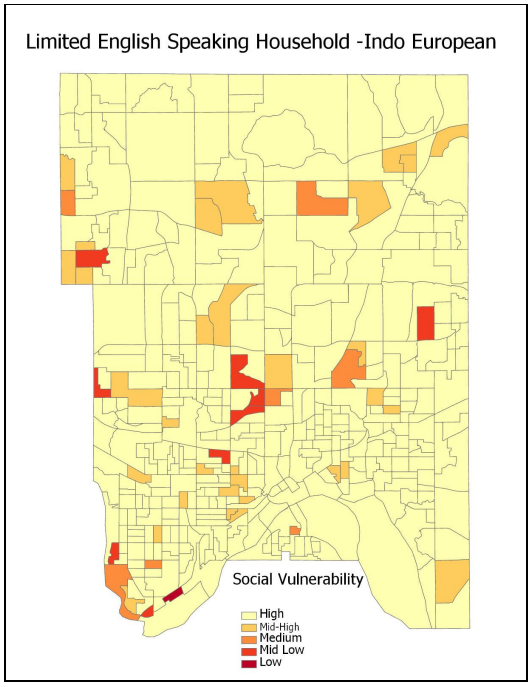
Mapping Results

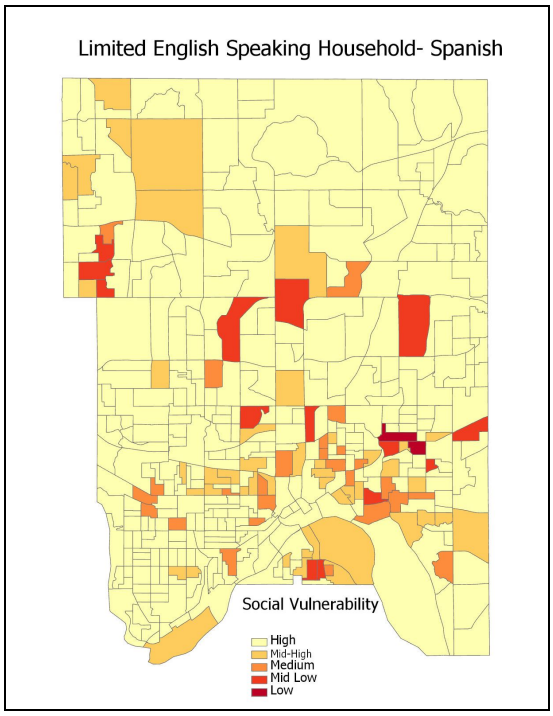
Before we had narrowed down the scope of our project, we did some initial social vulnerability mapping. Below is documentation of our first attempts.

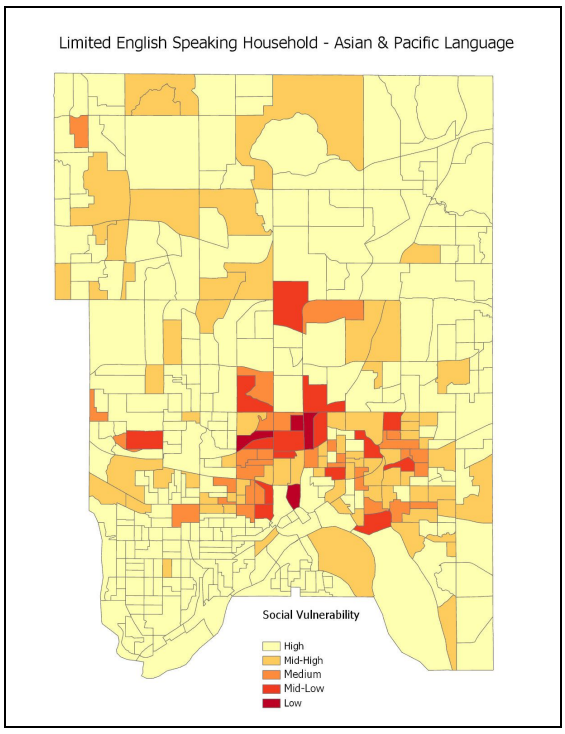








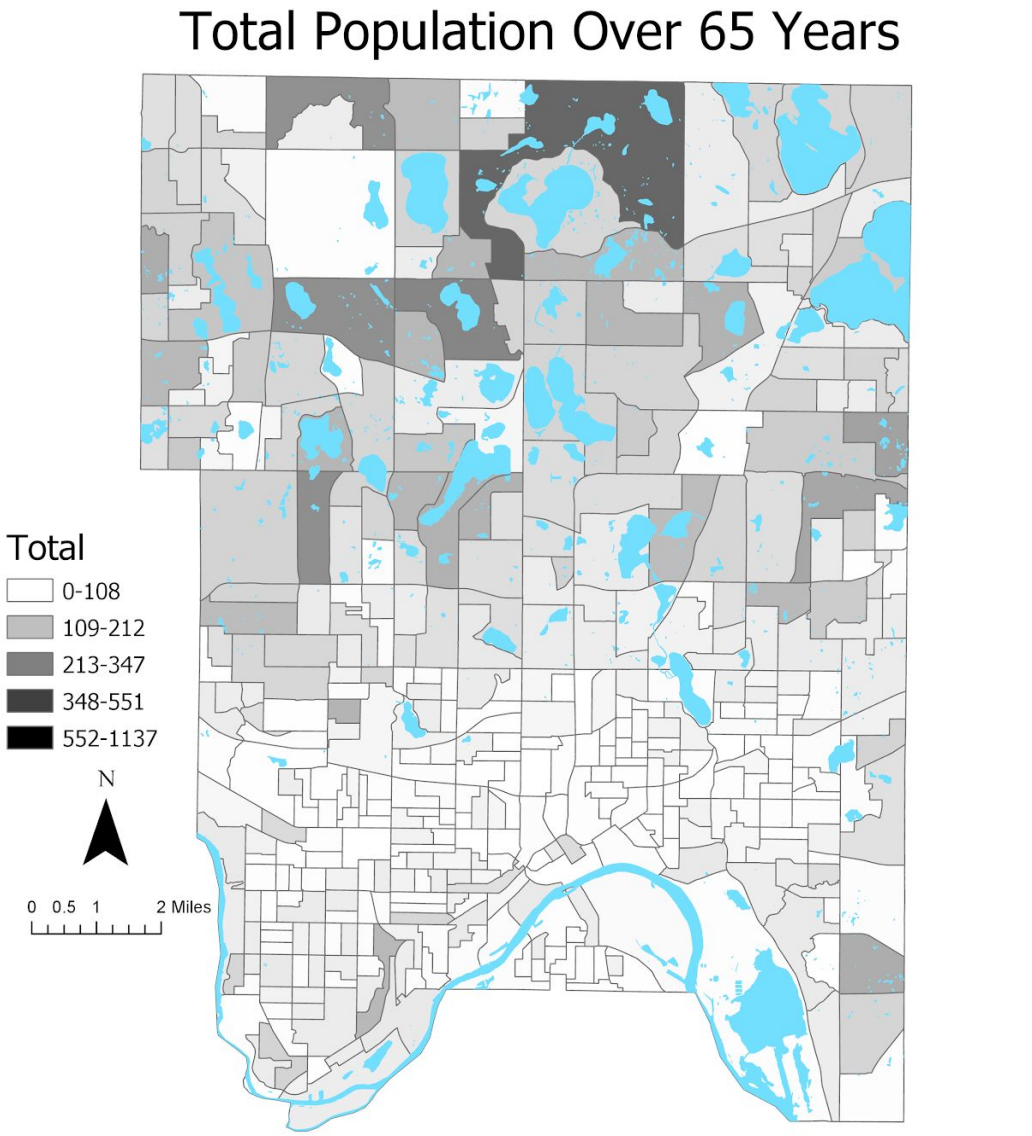




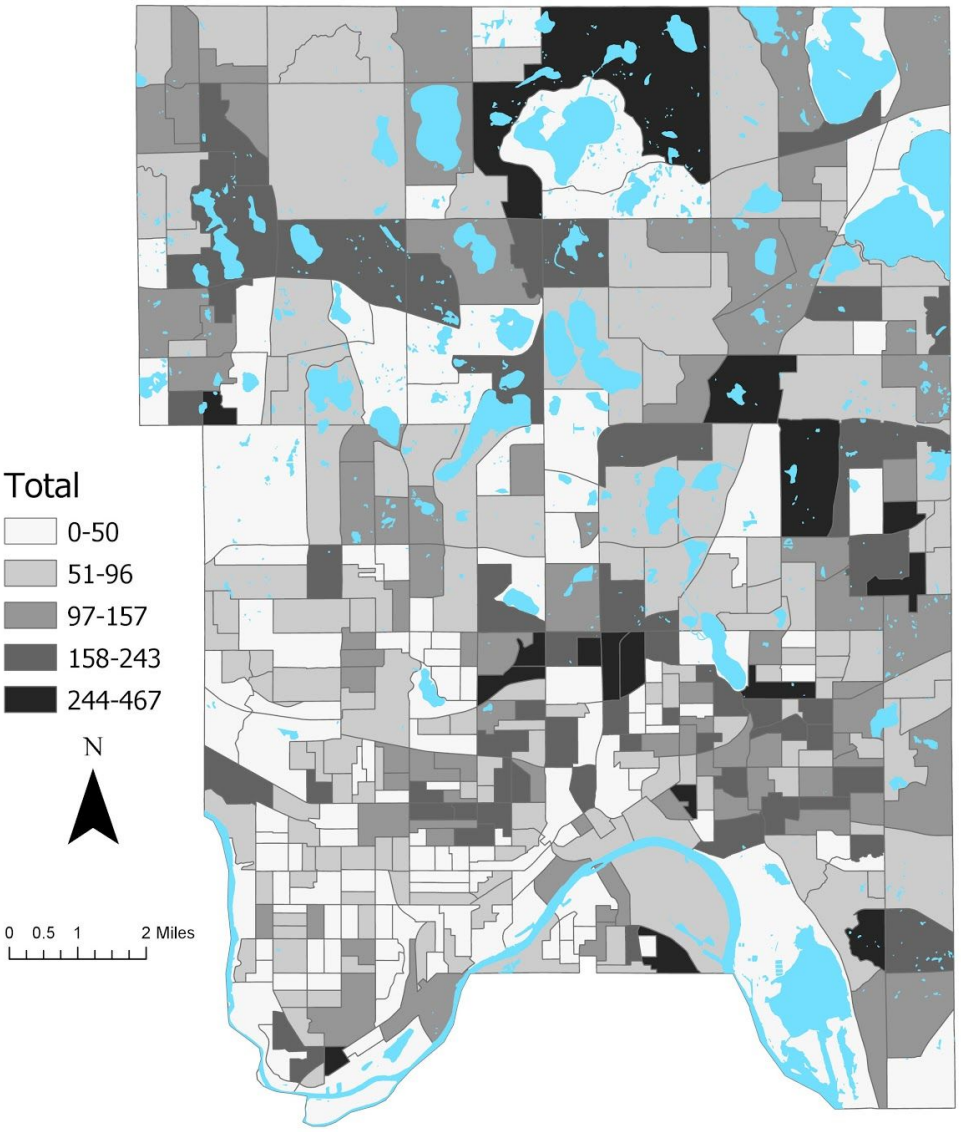
While these initial maps contain some errors, they functioned as a good way to learn about the mapping process and they show how many different maps could be made as part of this

project. Since there were so many possibilities, narrowing down the scope was a key factor during the semester.

Final Mapping Results and Analysis

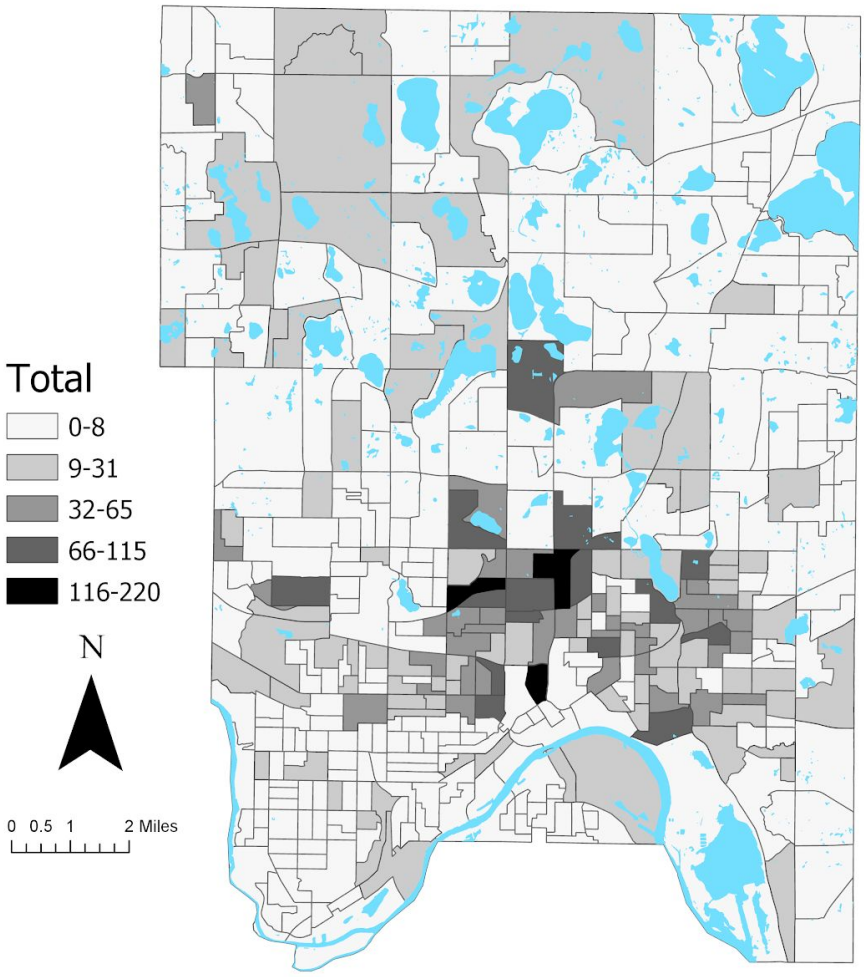


Total Population Under 5 Years



Data source: US Census Bureau
Spatial Reference: WGS 1984 UTM Zone 15N

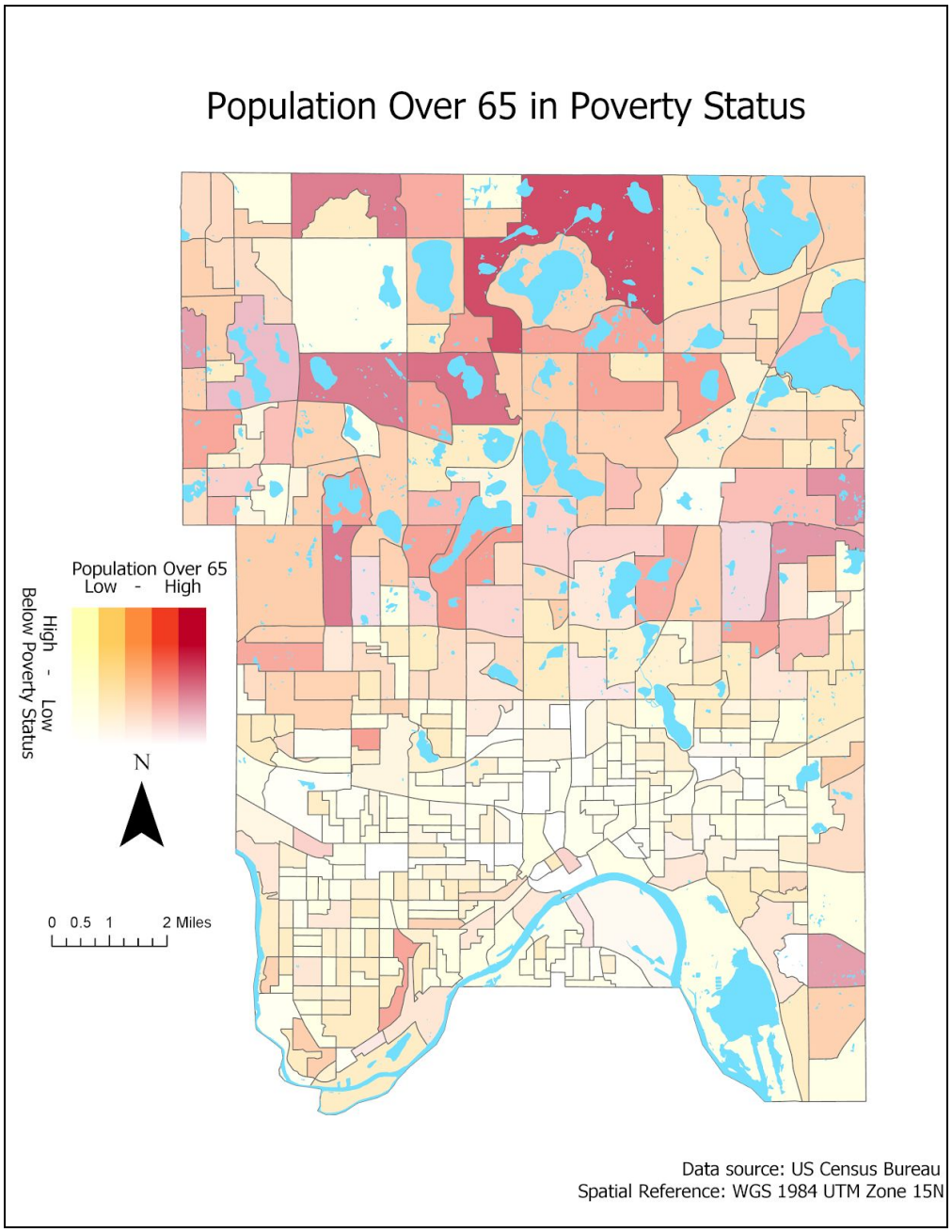
Limited English Asian and Pacific Island Speaking Households



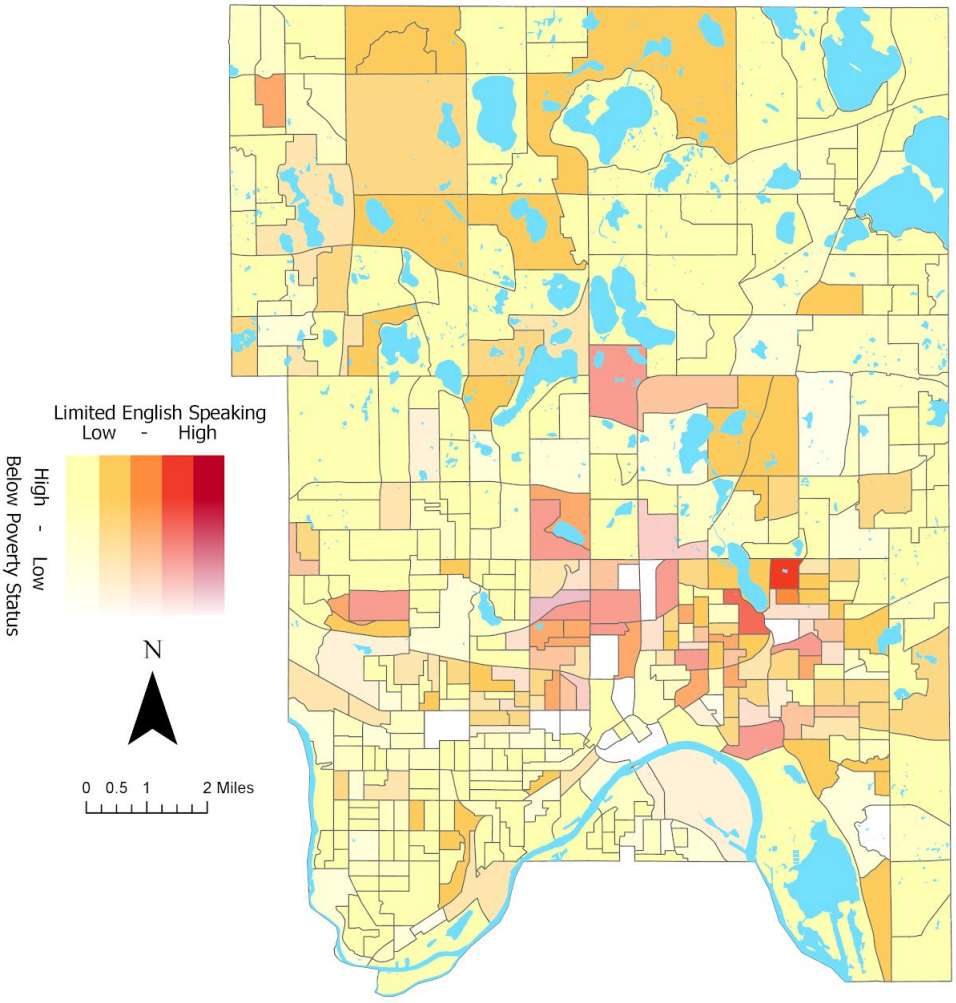
Data source: US Census Bureau
Spatial Reference: WGS 1984 UTM Zone 15N

The maps of individual indicators show the spatial distribution of these populations within Ramsey County. People over 65 years of age tend to be clustered away from the urban center of St. Paul, in the north-west suburbs, while limited English Asian and Pacific Island households are concentrated in the urban areas of St. Paul.

After mapping the individual factors, bivariate choropleth mapping was used to link economic status (poverty level) with two other vulnerability factors: limited english proficiency and population over 65 years, to show areas of high correlation, which we can associate as higher levels of vulnerability.



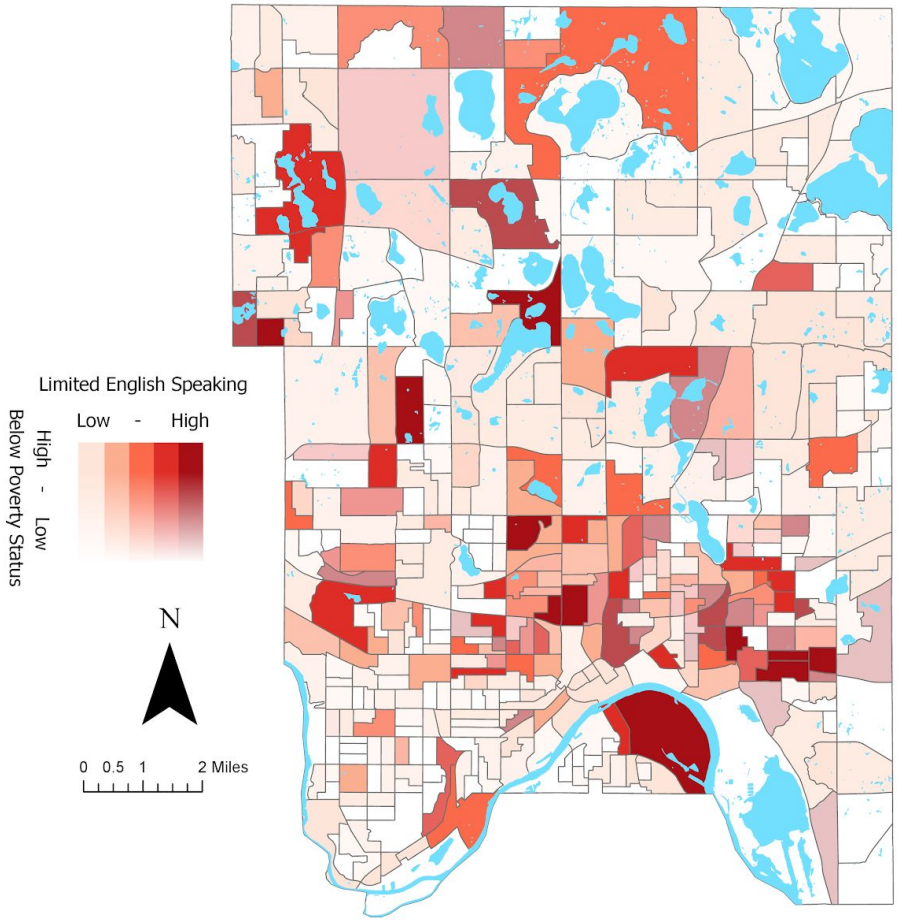
Limited English Asian and Pacific Island Speaking Household in poverty status



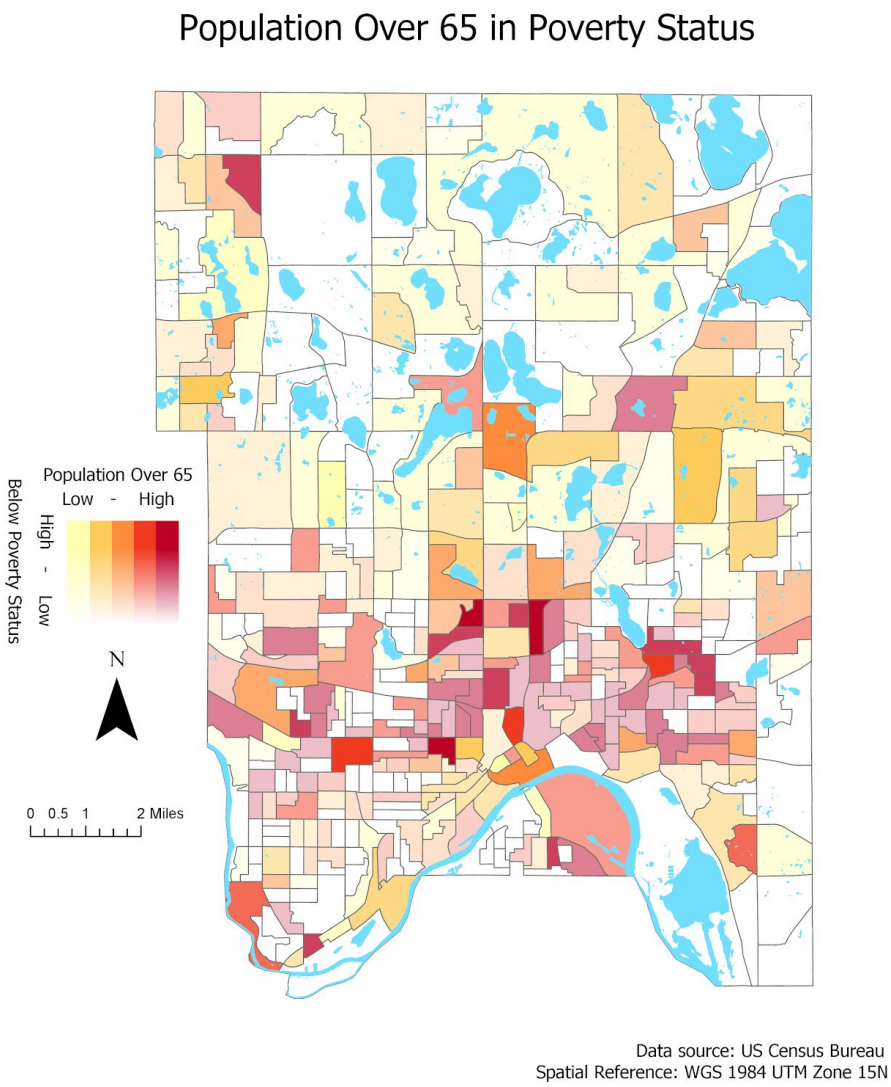
Data source: US Census Bureau
Spatial Reference: WGS 1984 UTM Zone 15N

Corrected Version of Final Maps

Limited English Asian and Pacific Island Speaking Household in poverty status



Data source: US Census Bureau
Spatial Reference: WGS 1984 UTM Zone 15N



Discussion of Final Maps

These maps were adjusted after the final presentation on 5/2/19, after receiving feedback from RCP and Dr. Song. The main conclusion from these maps is that the combination of Limited English Proficiency and Poverty is a greater indicator of social vulnerability than Age over 65 and Poverty. This is because there are more block groups with a high correlation between Limited English and Poverty, which can be seen in the band in/near downtown St. Paul where there are many block groups categorized as having a moderately high or high correlation between these factors. In the map with Age over 65 and Poverty, the highest correlation also exists in the band in downtown St. Paul, however the majority

of block groups show a moderate correlation, with fewer block groups having high number of people over 65 who are living in poverty (indicated in dark red).

Areas with high concentrations of populations that have limited English proficiency correlates with high levels of poverty, and block groups that have high rates of both vulnerabilities should receive additional support and resources from emergency management as they would fall higher on the social vulnerability index.

Limitations & Future Research

The timeline of the project was a constricting factor in mapping vulnerabilities. The vulnerabilities that we selected were chosen in consultation with Ramsey County officials to align with other research being done on social vulnerability in a Humphrey School capstone course - PA 8081. This decision allows the emergency response team to receive the most comprehensive assessment of risk possible in a short time frame because the maps will contextualize the research, and can be used in conjunction to identify ways to improve emergency response methods for these three communities.

To continue this project, Ramsey County can follow the steps outlined in the Methods section to map more of the vulnerability indicators that were identified in the introduction. The ability to map these indicators could be limited by access to block group data, although most demographic and socioeconomic indicators are included as datasets in the Census, it may be difficult to locate data on indicators such as health and sanitation.

Once a sufficient number of indicators have been mapped, the next step will be to overlay them and create a comprehensive social vulnerability index. It is necessary to create a weighted scale, in order to classify and identify which combination of vulnerabilities have the biggest impact on resilience. In the scope of this project, we were not qualified to create this weighted scale, which would depict which vulnerabilities are most important to focus on in emergency management, since we are not familiar enough with Ramsey County resources and social vulnerability research.

References

US Census Bureau: 2013-2017 American Community Survey 5-Year Estimates from American Fact Finder https://factfinder.census.gov/faces/nav/jsf/pages/searchresults.xhtml?refresh=t

US Census Bureau: 2017 TIGER/Line® Shapefiles: Block Groups https://www.census.gov/cgi-bin/geo/shapefiles/index.php?year=2017&layergroup=Block+Groups

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